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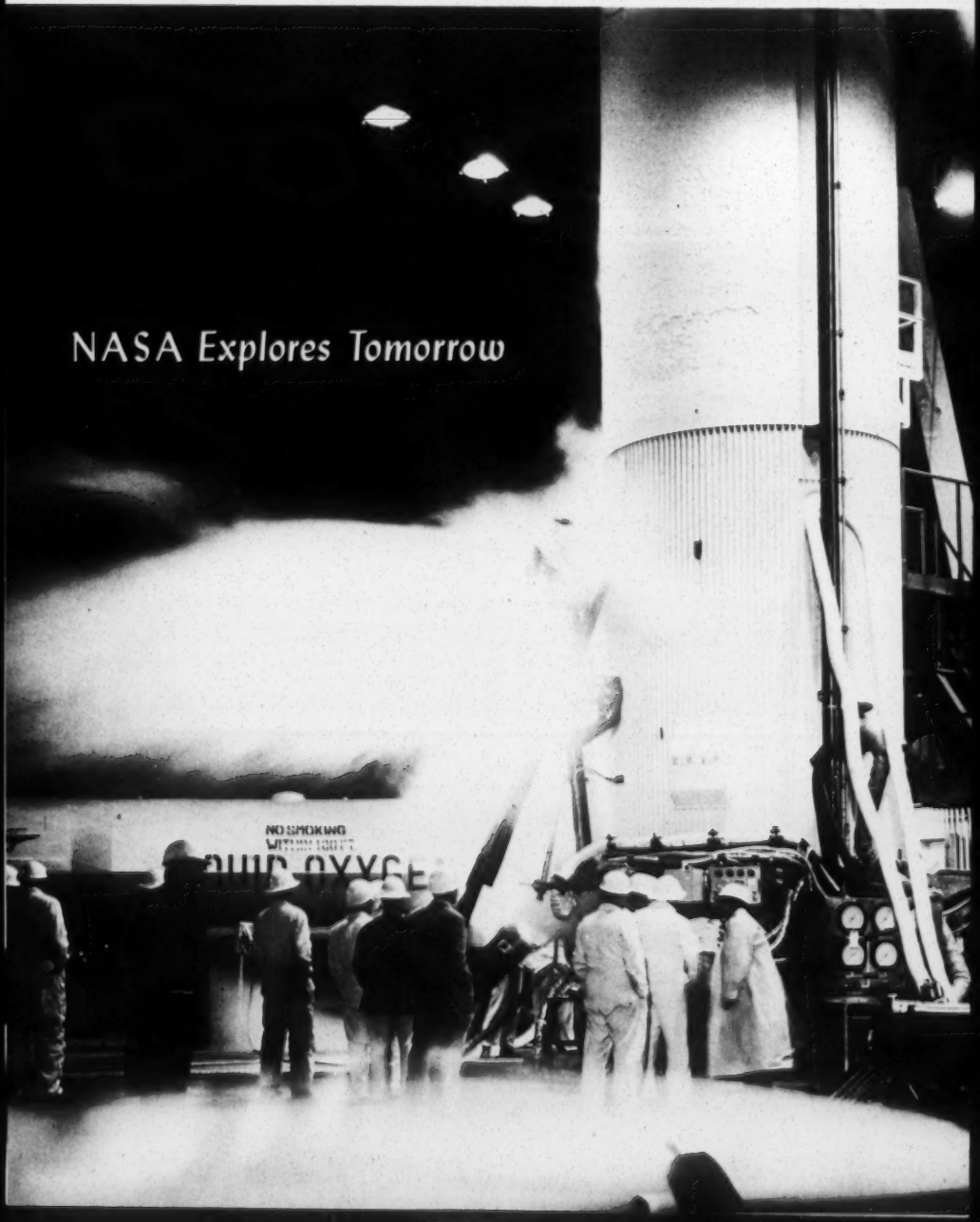

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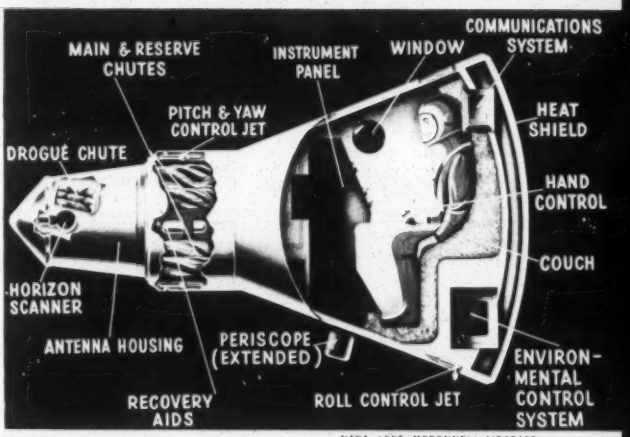

NASA. LEFT: MCDONNELL AIRCRAFT

SANTA MARIA, 1960 – The Project Mercury ballistic capsule, designed to carry a space-age Columbus outside Earth's atmosphere, is shown in diagram and in full-scale model. To enable the astronaut to live and function, the capsule carries an imitation of our planet's atmosphere – oxygen, livable temperature, air pressure (controlled by the environmental system, lower right). The periscope and window will give man's first views of Earth from the heavens. Jets of hydrogen peroxide vapor will control roll, pitch, and yaw to steady the capsule in flight.

Leaving the atmosphere the funnel-shaped container will fly small end first. Before the smashing return, the pilot will flip it over so that the blunt heat shield will receive the blow. The shield is coated with a glass fiber that will vaporize under the savage blast of air friction and stream away, carrying with it most of the intense heat.

Temperatures on the shield may reach 2,600° Fahrenheit, but within the insulated, double-walled hull, the maximum should be 120°, easily tolerated by the astronaut in his air-conditioned space suit. Each vital mechanism in the capsule has a backstop mechanism that will take over in case of failure.

At firing time two small rocket engines are attached to the capsule (left). From their concrete blockhouse beside the launching pad, scientists will carefully monitor the performance of the basic rocket – in the earliest "lob" shots a Redstone, in the later orbit shots, an Atlas. If anything goes wrong, the escape rocket perched on the girder above the capsule snatches the capsule off the booster rocket and lets it parachute to safety. Cluster of "retro-rockets" on the bottom is used to slow the capsule in space to allow it to fall to Earth. Both rocket systems are dropped before the capsule lands.

Coming down, the small drogue chute slows the capsule enough to allow the main parachute to be released. When the space craft lands in the ocean, it automatically releases a tiny blimp that lifts a radio antenna. Signals guide search ships and planes.

UMI

Reaching toward SPACE

NGS PHOTOGRAPHER DEAN CONGER. COVER, U. S. AIR FORCE

IN YEAR 4 of the Space Age, man is ready to take the first step up the stairway to the stars.

Early in 1961, if present plans are carried out, some modern Columbus, lying on his back in a monstrous costume (right), will feel a mighty rocket slam him into the sky to cross the greatest frontier—the one that lies only 125 miles from your front door, straight up.

Exploration today moves with amazing speed. From the first frightened venture beyond sight of land to the discovery of the New World required tens of centuries. This new conquest has become possible since October 4, 1957, when man first orbited a satellite—the Russian Sputnik I.

Today we confidently expect to shoot our man into space next year; to place instruments on the moon by 1962; and to explore the surface of the moon in person sometime after 1970.

The first "admiral of the ocean space" will be aloft only 16½ minutes, hurled 125 miles above Cape Canaveral by a Redstone rocket. He will not go into orbit, but will arch over the Atlantic to land 200 miles east. His capsule (diagrammed below) will bob in the blue waters until picked up by a waiting ship.

The United States effort in space is under command of a young government agency called the National Aeronautics and Space Administration, or, more familiarly, NASA. Although a late-comer to the field, NASA has scored some impressive triumphs—such as the weather-watching satellite, *Tiros I* (see *Geographic School Bulletins* October 10, 1960), and *Pioneer V*, the space probe that radioed information to Earth from millions of miles away.

Recently, *National Geographic* assistant editor Allan C. Fisher, Jr., completed a three-month tour of NASA's installations. In the July 1960 *Geographic*, Mr. Fisher reports: "I talked frankly and at length with (Continued on page 76)

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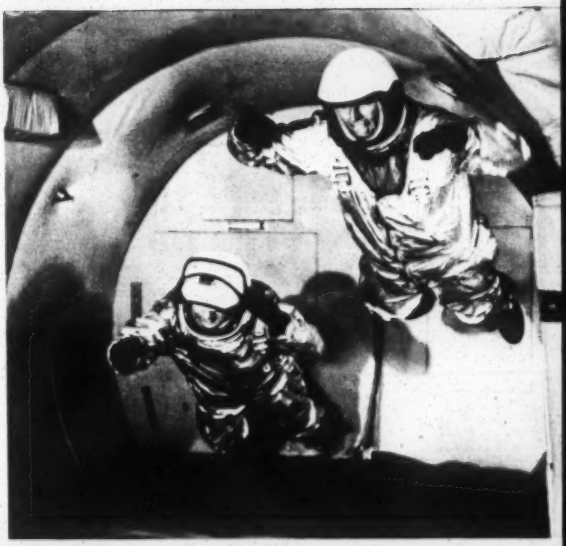


Although Project Mercury and the mighty rockets catch the imagination, other parts of NASA's program may prove as important in the long run.

No nation, for example, can send men to the moon and back until it develops new space craft materials that will withstand unprecedented heat and stress. New aerodynamic shapes must be developed as well.

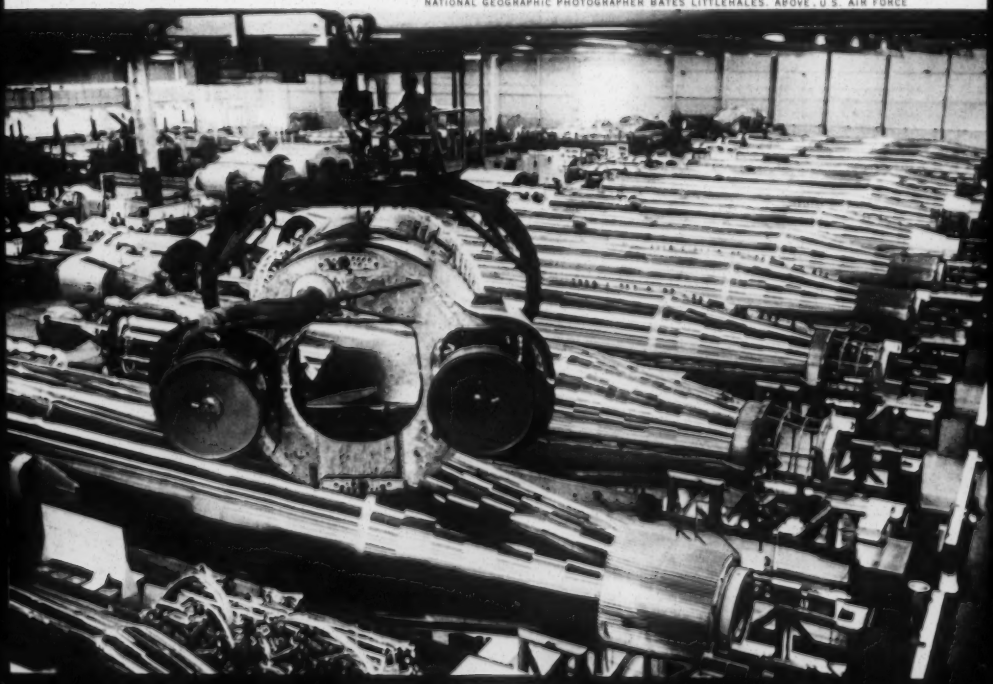
And stresses on equipment are only part of the story. More must be learned about the ability of men to function in the peculiar grip of space.

When the centrifugal force of a whirling satellite equals the pull of Earth's gravity—the balance of forces that keeps a satellite in orbit—the astronaut and all else in the capsule will be weightless.

Reactions to this state are being studied at Wright-Patterson Air Force Base, Ohio, in tests like that pictured above. Here, two of the astronauts—Capt. Virgil I. Grissom, USAF, and Capt. Leroy G. Cooper, Jr., USAF—float like thistledown inside a C-131B airplane. The plane flies up and over a roller-coaster arc, producing about 15 seconds of weightlessness. In such tests the astronauts have practiced eating soups and juices squeezed from plastic bottles. For the short periods tested, weightlessness does not affect the body's function. F.S.

Triple-engined Atlases, America's first intercontinental rockets, take shape in a plant near San Diego. Overhead crane swings twin-nozzled booster unit into position.

NATIONAL GEOGRAPHIC PHOTOGRAPHER BATES LITTLEHALES. ABOVE, U.S. AIR FORCE



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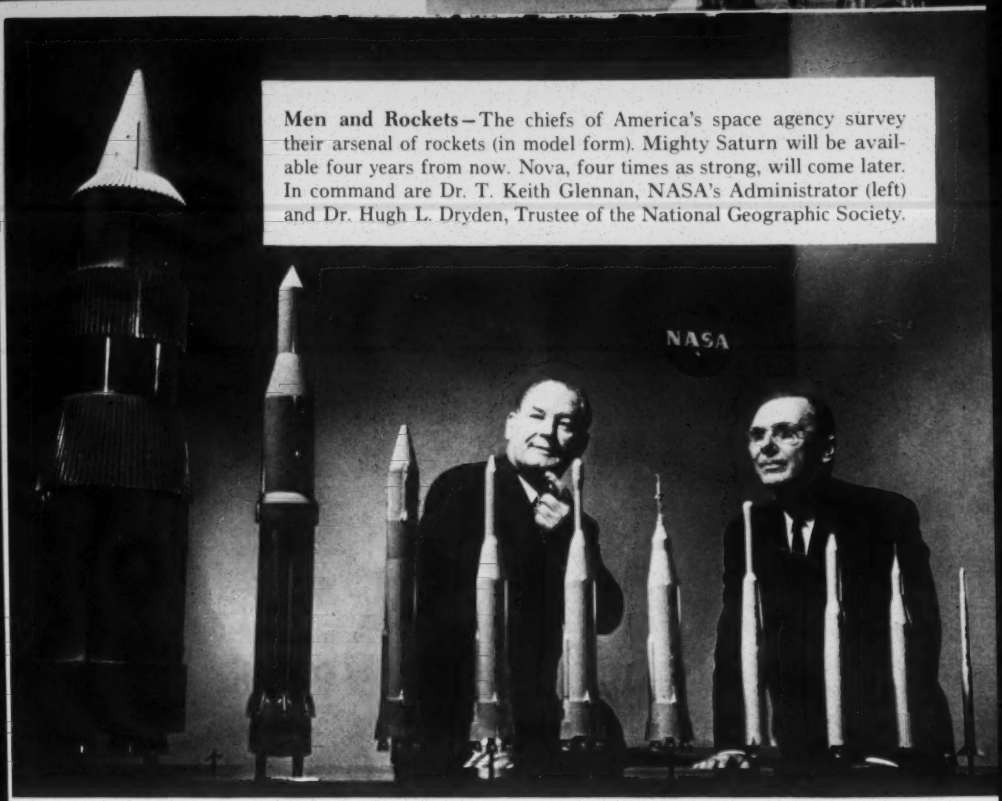


Men and Rockets—The chiefs of America's space agency survey their arsenal of rockets (in model form). Mighty Saturn will be available four years from now. Nova, four times as strong, will come later. In command are Dr. T. Keith Glennan, NASA's Administrator (left) and Dr. Hugh L. Dryden, Trustee of the National Geographic Society.

NATIONAL GEOGRAPHIC PHOTOGRAPHER DEAN CONGER

Nova Saturn Centaur Atlas-Agena B Atlas-Able Atlas-Mercury Delta Thor-Agena B Juno II Scout

scores of researchers and top administrators, witnessed many bizarre experiments, and gained an intimate insight into plans and problems.

"This searching examination convinced me that our future position in the space race will be far stronger than NASA's critics predict."

Already, the American program can claim far more satellites and probes than the Russian. The space timetable for the next ten years features some 250 launchings.

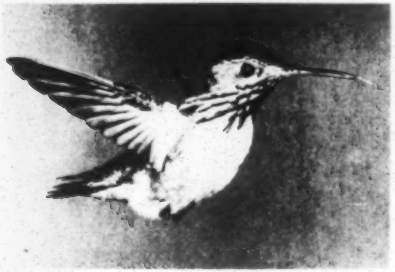
Dr. T. Keith Glennan, NASA chief, declares that even today our efforts compare favorably with those of the Soviets. "We have a soundly based program, technically and scientifically," he told Mr. Fisher. "That is what will be most useful to the world. Unless the Russians do something vastly different from what they have done to date, we have a better program.

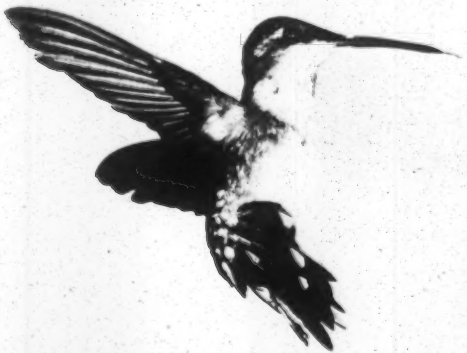
"I do not say this in derogation, but the information that has been retrieved from the heavens leaves the balance in our favor. We must make the American public aware that the be-all and end-all of space exploration is not to match the Russians shot for shot."

Still, many NASA officials, as well as the seven astronauts, from whom the first American space man will be chosen, believe that the Soviets may beat them into space. Project Mercury, the American effort, goes ahead at a fast pace with the highest priority, but the competition got an earlier start. Russia has rockets with twice the thrust of our strongest, and could launch a heavier, more versatile craft than the Mercury capsule—perhaps one with two men aboard.

More powerful American rockets, such as the 220-foot-high Nova and the 150-foot Saturn (above) are under development.

Male *Stellula calliope* wears a purple collar. Calliope means "beautiful voiced"—a misnomer, for most hummingbirds sing no songs.



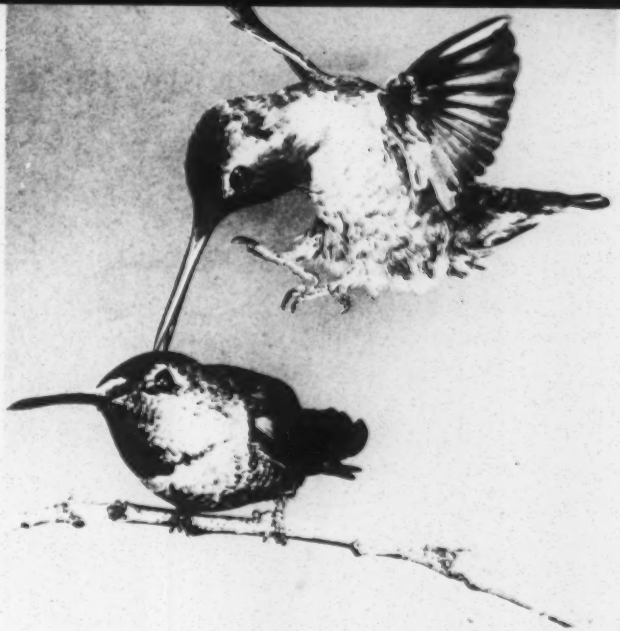


bird is its power plant. If a man put out the energy this bird expends, he would have to consume in one day 285 pounds of hamburger or 370 pounds of boiled potatoes.

To keep up its energy supply, the hummingbird eats half its weight in plant sugars every day—and adds a few insects. If artificial feeders are provided, hummers will come in for snacks every 10 or 15 minutes.

The birds are fearless, curious, and pugnacious. They seem to enjoy a good rough-and-tumble. At right two Anna's hummingbirds battle at a California feeding station.

Like most other birds they establish territories which they defend with uncommon valor. By diving and striking, they have been known to rout hawks a hundred times their size. In the wilderness, they will come to within 5 or 10 feet of a man. In civilization they get so used to people they will perch on a finger. L.B.



The elusive colors and rapid wingbeats—sometimes 80 beats a second—of hummingbirds have long challenged photographers. These remarkable pictures were made at speeds ranging up to 30 millionths of a second. They are the fruit of the hobby of Crawford H. Greenewalt, president of Du Pont, and National Geographic Society Trustee. Mr. Greenewalt traveled 100,000 miles in seven years to film the different species. In effect, the birds took their own pictures by flying through a beam of light shining on a photocell that tripped shutter and flash.

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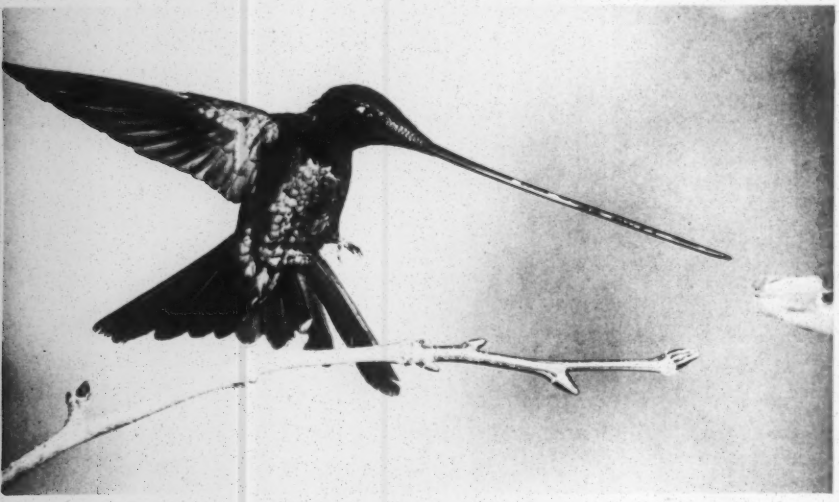
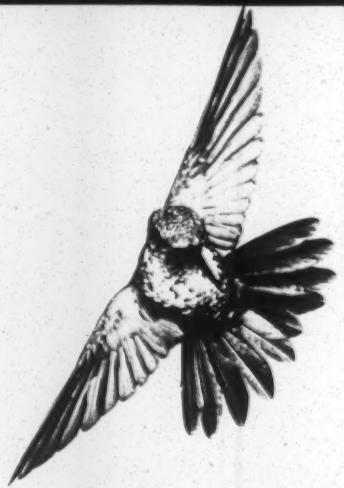
HUMMINGBIRDS— Fast-Flying Feathered Jewels



More beak than bird. No other hummingbird can match the length of this bill. It gave the species the name *Ensifera ensifera,* "sword bearer" of the Andes. Even more than his relatives he is equipped to suck nectar from the deepest flowers. In the hummingbird world there are long and short bills, sickle-shaped and broad bills. Whatever the beak's shape, a long tubular tongue extends beyond, so hummingbirds can suck their fuel quickly and efficiently. At right is the feeder the photographer used to attract his subjects. Some wary birds had to be tricked or forced to pose. Some had to be shooed away so others could take their turns.



A FRENCH NATURALIST once said of the hummingbird: "(Nature) has loaded it with all the gifts of which she has only given other birds a share."

For the tiny hummingbird, which gets its name from the sound of its wings, is as versatile as it is beautiful.

The flying acrobat at right, with gleaming green body and purple wings, performs its stunts over Venezuela, Trinidad, and Tobago. He and his relatives can fly nearly 30 miles an hour, or shift into reverse—the only birds that can. They can also fly sideways and straight up, like a helicopter. They are the only birds that can hover with bodies motionless.

Creatures of the Western Hemisphere—North, Central, and South America, and islands of adjacent seas—hummers are found nowhere else. The more than 300 species live in all altitudes and climates—from mountains to deserts.

In the United States, only the ruby-throat, right, nests east of the Mississippi. It winters in Central America. Eleven species breed in the West.

The family includes the smallest bird known to man: a Cuban native called the "bee," about 2¼ inches long. The largest hummingbird is about 8½ inches in length.

Perhaps the most extraordinary thing about the humming-

cleanse itself. But usually, more pollution is added before the stream can clean up from the first batch—and so on along its course.

Perhaps at this stage, the drop joins millions of its fellows and is sucked into a paper mill. Used for dissolving chemicals in the papermaking process, it is dumped out below the stream as a poisonous black liquor that kills any fish or insect that may venture into it.

Or it may be used as a coolant in a manufacturing process, and returned to the stream so warm that it supports a growth of stream-choking bacteria.

Always moving downhill, it arrives at the water works of its first small town, is sucked in, treated with chemicals to kill its germs, piped to a home for a Saturday night bath. Dumped again into the river—either after another treatment to clean it, or else still laden with soap and dirt—the drop goes on until stopped by a dam.

Standing still for a minute, it loses energy, and drops some of the grit it picked up. Then with a whoosh it falls down the penstock, whacks the turbine blade to produce electricity, and falls out below.

Or perhaps from the dam's reservoir it is piped off to water a field and form part of a plant's lifeblood. A plant-eating animal may devour it. Through this chain it may return to the sky by evaporation or find its way slowly back into its stream—or another.

If it remains in the stream after meeting the dam, the drop may help float a canoe over the rocks of a riffle, or dampen a kingfisher diving for minnows.

As it broadens, the river becomes a highway edged with other highways. As along the Susquehanna, below, roads and railways follow the course the raindrops have cut in hills.

The valley is now wide enough to hold farms and cities, as well. Our raindrop may be tumbled in the wake of an outboard motorboat, or whacked by a water ski.

It may float a huge chain of deep-loaded barges to a steel plant—or quench the heat of red-hot ingots. It may pass through several more water systems and sewers before winding somewhere safe to sea. Then the mighty sun may pull it up into the sky to start the process again. F.S.

WALTER MEAYERS EDWARDS, NATIONAL GEOGRAPHIC STAFF

UMI

First of a series

The Living River

NATIONAL GEOGRAPHIC PHOTOGRAPHER B. ANTHONY STEWART

A DROP OF WATER isn't much; but with others it can shape continents—and our lives.

Enough raindrops, rolling downhill, make a river, capable of breaking mountains or nourishing civilizations.

Man's earliest communities grew up around rivers—in particular the Nile, the Tigris—Euphrates, the Ganges, and the Hwang. Today men are still concentrated in river valleys, seeking the fertility, transportation, power, and recreation they offer.

This series will discuss the river and the life that flourishes in and around it—not a particular river, but *the river* as a geographic concept.

There are many different kinds of rivers—short and long, fast and slow, mild and brawny; even one, they say, that is dusty—the Rio Grande.

Our picture of a river begins by imagining a raindrop landing on a mountain. It spatters on the wet rock. Gravity pulls it down, joining it with others to trickle through moss and enter a tiny stream. Losing identity, it picks up momentum in the swelling onrush.

Still on the mountainside, it joins a rill skipping over rocks, splashing whitely into little pools, flowing sweet and cool into a bigger stream.

Here it may caress a vibrant trout or attempt to find a hole in a fisherman's boots. "Jesus bugs," the insects light enough to walk on the water, may dimple it with a foot print.

Or it may make this part of its journey underground, to emerge miles away as a spring. The boy above leaps over the insignificant beginnings of the mighty Mohawk River in a pasture near Rome, New York.

As the stream gathers power, the water drop may act as part of a lever that lifts a rock and cracks it against another, producing perhaps a grain of sand—or a split rock. Whenever the drop rubs against something it tends to wear down the surface. If strong enough, it may pick up a piece of grit to use as a chisel or rasp on whatever it strikes.

If its beginnings are forested or carefully farmed, the stream should flow clear. But many turn muddy soon, with bits of soil picked up in fields or bare soil.

As soon as it passes its first house or pasture, the raindrop is likely to be polluted. If given time, and air, it can

discovered the treasure, one of the richest deposits of fossil dinosaur bones ever unearthed. Since discovery, a million pounds of petrified bones have been removed. Many have been assembled for view in Pittsburgh, New York, Lincoln, Denver, Salt Lake City, and Toronto, as well as in Washington.

The 80 acres enclosing the famous Dinosaur Quarry were set aside as a national monument in 1915. Visitors see where rock has been chipped away to outline bones in relief. When exposed to air the bones begin to disintegrate. The monument worker above shellacs a fossil to preserve it until it can be removed. The vast paleontological trove is in little danger of being mined out.

But fossils are only part of the Dinosaur National Monument. In 1938 its boundaries were extended to include 328 square miles of beauty. Spectacular river-carved canyons drop vertically to cool, green glens. Cliff walls blaze in rich red-brown, buff, salmon, gray, white, and vermilion. Mountains tower nearly 10,000 feet high. Cottonwoods flame in autumn. Dusty trails are better fitted to pack horses than to cars, although there are several points where one may drive to the rivers or to overlooks.

The heart of the monument is Steamboat Rock, named for its prow-like shape. There two rivers meet—the powerful Yampa, cutting a canyon as it pours in from the east, and the broad Green, meandering down from the north. Below the junction, the Green slices through Whirlpool Canyon and Split Mountain Canyon before it spills into the open Uinta Valley of Utah on its way to join the canyon-studded Colorado River.

A thrilling but educational method of viewing Dinosaur's scenic wonders is to go by rubber raft through the canyons. Professional boatmen take parties over placid and raging stretches with equal skill. Trips often start at Lily Park on the Yampa and end below Split Mountain Canyon. (See "Shooting Rapids in Dinosaur Country," in the March 1954 *National Geographic.*)

Earth's history, chapter by chapter, is laid bare in the exposed rock layers that form the canyon walls (next page).

NATIONAL PARK SERVICE

Straddling the Colorado-Utah border, Dinosaur National Monument preserves a region of natural beauty and scientific treasure. The rock cliff containing Dinosaur Quarry forms the north wall of the visitor center (right). Inside, workmen mine fossil bones.

UMI

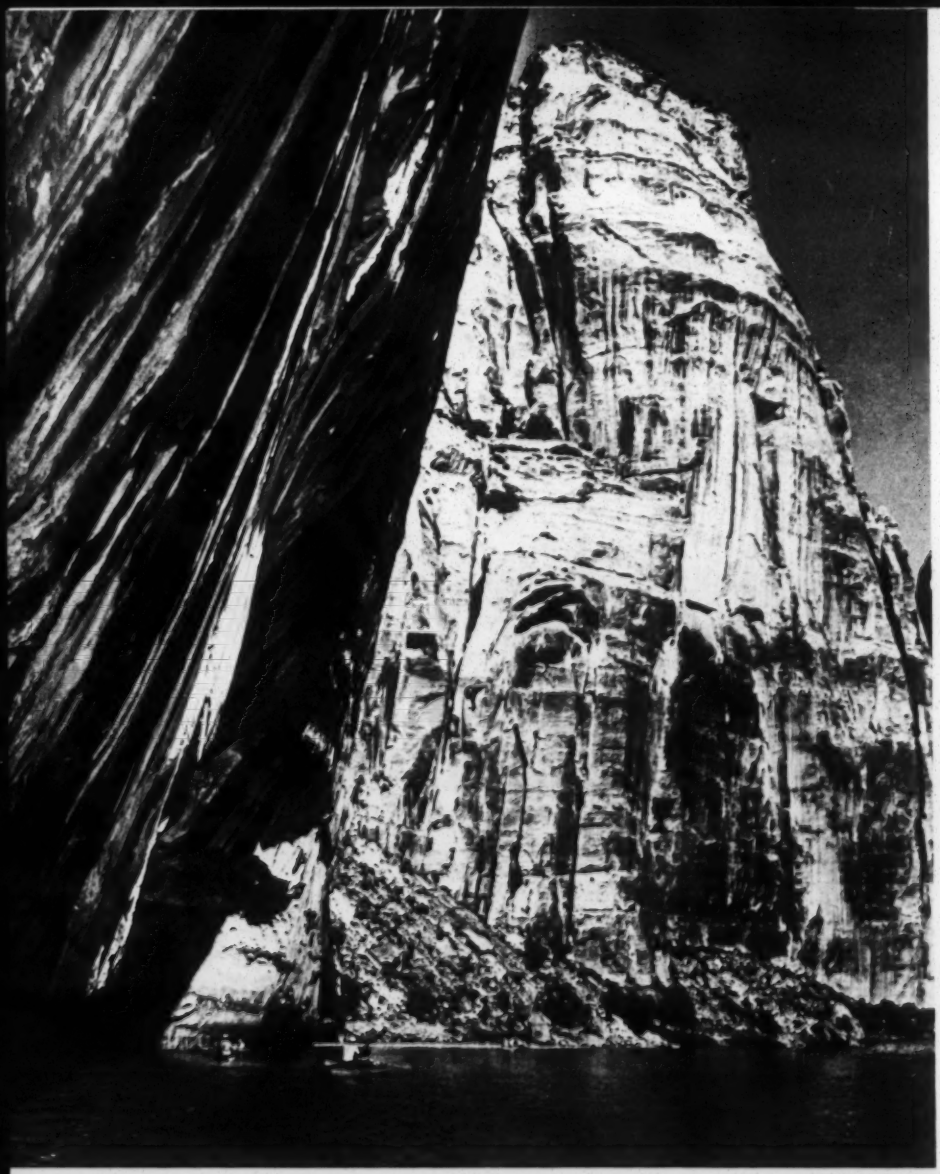
NATIONAL GEOGRAPHIC PHOTOGRAPHER BATES LITTLEHALES. BELOW, JUSTIN LOCKE

Monument to the Dinosaurs

BOYS AND GIRLS gaze in awe at a 70-foot-long reconstructed diplodocus skeleton in the Smithsonian Institution, Washington, D.C. Once fat and healthy, the dinosaur lumbered through Utah and Colorado when they were parts of a vast tropical plain stretching as far as the Mississippi River. He feasted on lush vegetation. When he and his reptilian relatives died, sluggish rivers washed their carcasses against a great sandbank, and there they piled up.

Layer after layer of river silt covered the bones, petrified them, and gave the land a new surface. Eventually mud turned to rock thousands of feet thick. Then the tremendous forces within the Earth lifted the former plain and tilted the rock layers. Erosion set to work and bared the beds of dinosaur bones.

In 1909, Dr. Earl Douglass of Pittsburgh's Carnegie Museum



HAROLD C. BRADLEY

IN A WILDERNESS OF ROCK, boatmen find a highway for exploration of Dinosaur National Monument. The tawny walls of Yampa River Canyon rise 1,400 feet above them in places. The tiger stripes result from mineral deposits. When plants live on higher ledges, their organic acids—washed down by rains—dissolve minerals in the rock. Combined with oxygen, these form an oxide which colors the stone.

As in many of the region's canyons, the river here undercuts the canyon wall. In some places this undercutting is so great that a stone dropped from the top lands across the stream.

Some overhangs along the Yampa's churning course shelter fire pits and granaries built by Indians 10 to 15 centuries ago. Flat rocks in the monument area display their paintings and carvings.

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